AOT & LANSCE The Pulse

March 2010

INSIDE

LANSCE beam reliability achieves "world class" ranking

AOT has issued the CY2009 Los Alamos Neutron Science Center (LANSCE) Beam Report for cumulative reliability. The cumulative performance for CY2009 covers the period from June 2-December 12, 2009. The results are displayed in the table below. The DOE Office of Science/Basic Energy Sciences considers a reliability standard of 85% to be "world class."

CY 2009 LANSCE Beam Reliability Report

Experimental Facilities	*Cumulative Reliability*
Manuel Lujan Center	85.25%
WNR Target 4	89.94%
Proton Radiography	91.74%
Isotope Production Facility	95.16%
Ultra-Cold Neutrons	84.79%
WNR Target 2	91.50%

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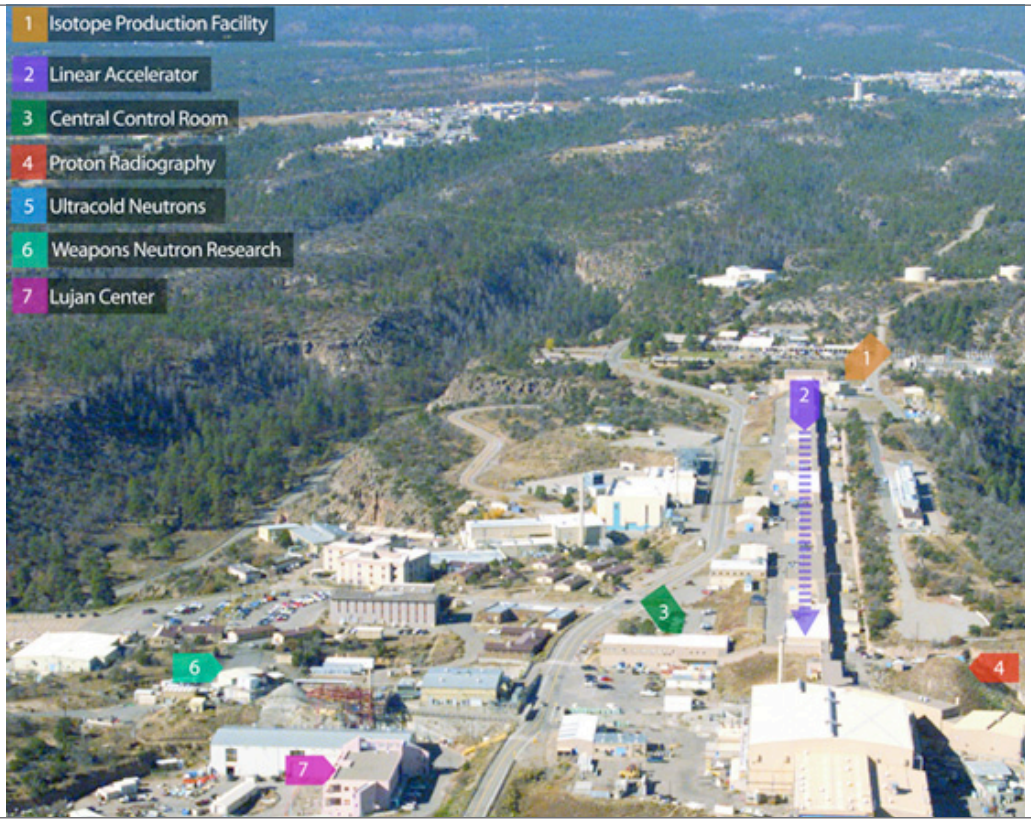
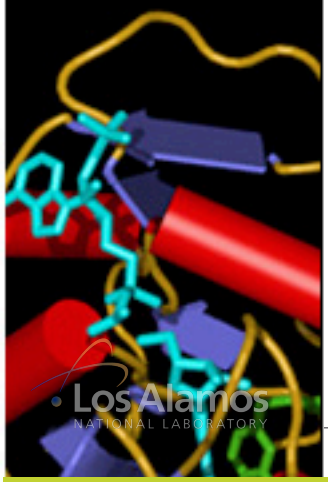
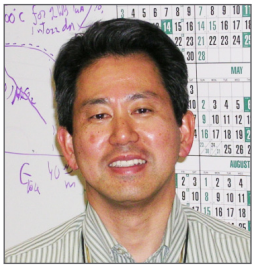




World class . . . LANSCE is a national resource that supports basic and applied research for national security and civilian applications. The heart of LANSCE is a highly flexible linear accelerator (linac) system, one of the most powerful in the world, that can accelerate up to 1 milliampere of protons to an energy of 800 million electron volts (MeV), and then deliver the protons to multiple experimental areas (see photo). The linac can also accelerate negative hydrogen ions to 800 MeV. The Isotope Production Facility uses protons at 100 MeV to make medical and other short-lived radioisotopes. The Proton Radiography Facility employs pulses of 800 MeV negative hydrogen ions to image dynamic events related to nuclear weapons performance. These pulses are also sent to heavy-metal targets at the Weapons Neutron Research (WNR) Facility, where proton–nucleus collisions in the targets generate large numbers of neutrons through a process called nuclear spallation. The neutron pulses are used for materials irradiation and nuclear science research. The negative hydrogen ions are also injected into the Proton Storage Ring, which compresses the 625-microsecond pulses into a 125-nanosecond (half-width at half-maximum) intense burst. Those intense proton bursts produce, through nuclear spallation, bursts of neutrons for neutron scattering studies of material properties at the Lujan Center and for nuclear physics research at the WNR. A newly commissioned ultracold neutron research facility is exploring fundamental nuclear physics to test the standard model of elementary particles. LANSCE facilities are available to qualified scientists and engineers through a competitive proposal process. The scientists who conduct experiments at LANSCE represent a cross section of the research community—universities, industry, and national and federal laboratories—and come from all over the world.

Tajima receives DOE Early Career Award



Tsuyoshi Tajima (AOT-MDE) is the recipient of a DOE Early Career Award for his proposal "Technology Development Toward Very High-Gradient and High Quality-Factor Superconducting RF Cavities."

He is among 69 scientists from across the nation to receive up to $85 million in funding under the American Recovery and Reinvestment Act for five-year research grants as part of DOE's new Early Career Research Program. The new effort is designed to bolster the nation's scientific workforce by providing support to exceptional researchers during the crucial early career years, when many scientists do their most formative work.

There is a fundamental accelerating gradient limit on superconducting radio-frequency cavities used in particle accelerators. The RF critical magnetic field of approximately 200 mT, corresponding to approximately 50 MV/m, creates this limit. Tajima plans to overcome this limit by coating another superconductor using a known effect of enhancement of critical field with thin films. This work would reduce the size and cost of particle accelerators and could open up a wide variety of compact accelerator applications. Tajima received a PhD in accelerator science from the Graduate University for Advanced Studies in Japan. He has worked at Los Alamos since 2000 at LANSCE for superconducting RF cavity research and development. Tajima is a team leader for vacuum systems.

Researchers will receive funding for salary and research expenses. Beginning with the next fiscal year, DOE's Office of Science plans to continue the program, choosing new candidates on an annual basis, and supporting them under annual appropriations. To be eligible for an award, a researcher must be an untenured, tenure-track assistant professor at a U.S. academic institution or a full-time employee at a DOE national laboratory, who received a PhD within the past 10 years. Research topics are required to fall within the purview of the Office of Science's six major program offices. Awardees were selected from a pool of 1,750 university- and national laboratory-based applicants. Selection was based on peer review by outside scientific experts.

Neutron reflectometry provides first sub-nanometer visualization of live cell adhesion

Neutron reflectometry (NR) at LANSCE's Lujan Center is used to probe the structure of thin films at various interfaces. Over the past 30 years, NR has evolved to become key in the characterization of thin films. Typically, NR measurements are performed on model systems in which samples are homogeneous over large areas. Because of their complexity and inhomogeneity, the measurement of live objects, such as cells adherent to a solid substrate, is a radical departure from a typical system measured via NR. However, in situ NR measurements of biologically relevant objects are needed to study the detailed structure and biophysics of cell attachment. Hillary Smith, Michael Jablin, and Jaroslaw Majewski (LANSCE-LC) and Joseph Hickey, Antoinette Trujillo, and James Freyer (B-9) used NR to examine living mouse fibroblast cells adherent on a growth media coated quartz substrate. This is the first visualization and quantization of the interface between live cells and a substrate with sub-nanometer resolution using NR.

The figure inset panels show a representation of how the cells behave in the adherence region. The membrane region, approximately 80 Å in thickness, contains the membranes of

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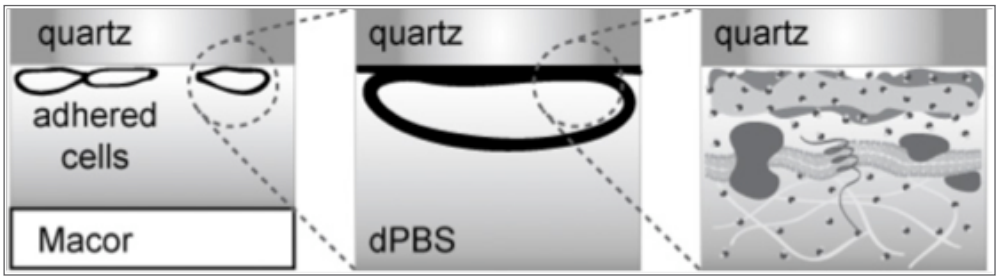
Cell adhesion . . . cells that are inhomogeneously distributed or undulating, likely conforming to the non-planar geometry of the supporting adherence proteins.

Reference: "Mouse Fibroblast Cell Adhesion Studied by Neutron Reflectometry," *Biophysical Journal*, in press. This work benefited from the use of the Lujan Neutron Scattering Center at LANSCE, funded by the DOE Office of Basic Energy Sciences. The National Cancer Institute, National Institutes of Health supported the work.

Technical contact: Jarek Majewski



Schematic of the NR measurements. The quartz substrate with adherent cells is clamped against a Macor disk with a 0.2-0.3 mm thick gap where the subphase (deuterated phosphate buffered saline, dPBS) is injected. The neutron beam penetrates the lateral face of the quartz substrate to reach the solid-liquid interface where the cells reside. Insets show a cartoon representation of how the cells behave in the adherence region. Immediately adjacent to the quartz substrate is a layer of adherence proteins (~120 Å thick), on top of which sits the membrane region (~80 Å thick), followed by a diffuse profile representing the interior of the cell. Small dots in the far right panel represent deuterated water molecules as a function of distance from the quartz substrate.

Creating a high-efficiency compact ion accelerator, an alternative to larger, more costly structures

Combining two existing research tools into one project has generated a unique accelerator with numerous capabilities.

AOT researchers Sergey Kuronney, Larry Rybarcyk, and Tom Wangler (all AOT-ABS), and Jim O'Hara, Eric Olivas, and Jim Witt (all AOT-MDE) collaborated to combine H-mode resonator cavities with the beam-focusing capabilities of permanent magnet quadroples (PMQs) in order to develop compact and high-efficient accelerator structures for light ions in low beam velocity.

The LDRD-ER project was originally developed to create compact and efficient structures for deuteron acceleration for homeland security applications. H-mode resonator cavities were selected because they are 10-20 times more efficient at the beam velocities around a few percent of the speed of light compared to the drift-tube linear accelerator (DTL), like the one at LANSCE. The H-mode accelerators also have transverse dimensions a few times smaller than the DTLs, making it more efficient in a smaller structure.

H-mode structures have been used since the 1950s for accelerating heavy ions, where, because it is difficult to focus the beam, currents must be kept low. To focus the H-mode structures for high currents, the researchers incorporated another existing tool, PMQs, to prevent the beam from self-destructing. PMQs for beam focusing have been used since the 1980s, but not specifically with H-mode structures

The researchers inserted PMQs inside the H-cavity small drift tubes, thus solving the focusing problem without any reduction of the accelerating efficiency. The researchers designed the structure by performing three-dimensional electromagnetic computations to calculate the radio frequency (RF) fields in the structure and PMQ focusing fields, and used these fields in beam-dynamics simulations. The researchers also used the calculated RF fields to determine the thermal load and modeled the cooling system with engineering software.

The H-PMQ accelerator has multiple applications, either in stand-alone accelerators or as a part of the front end of DTLs. Applications range from medical therapy (cancer treatment) to imaging (defect detection) to active interrogation. The research demonstrated that a compact and efficient structure for acceleration of high-current, low-velocity ions was possible, creating an alternative to larger and more costly accelerating structures.

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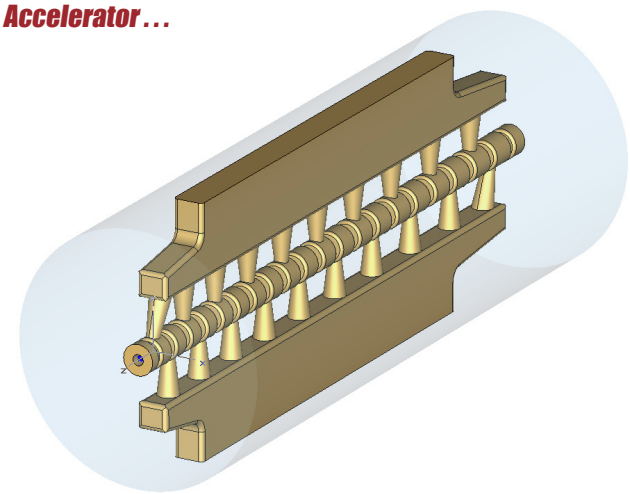
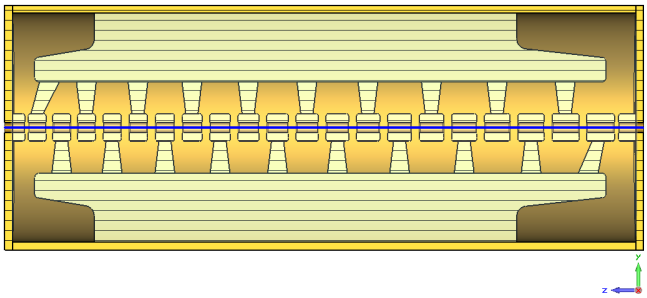
Accelerator . . .



MWS model of a short IH tank. The outer wall is removed; the cavity inner volume is in light-blue.



Cross section of the IH tank with the outer wall.

Technical contact: Sergey Kuronney.

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HeadsUP!

Temporary government parking placards issued in 2009 remain usable

Pending review and revision of the Parking Procedure (P908), all temporary government parking placards issued in 2009 will remain usable. The placards were issued to Laboratory organizations for use by drivers of private vehicles engaged in official Laboratory business. The placards are light purple and laminated, with an expiration date of 12/31/2009. All organizations may continue to use the placards until further notice.

Enforcement of private vehicle parking violations

Los Alamos now has a full-time Los Alamos Police Officer writing tickets for parking and other violations for private vehicles. If you are issued a ticket you must appear before the county magistrate. For government vehicles SOC will write tickets.

Areas of focus for private vehicles

- Handicap parking spots: Please ensure you placard is visible or you will receive a parking ticket.
- Private vehicles in government spots.
- Loading zones: Don't park more than 20 minutes.
- Two-hour visitor parking: Don't park more than two hours.
- Parking in a tow-away zone will result in a ticket, towing, and impound of your vehicle.

Areas of focus for government vehicles

- Handicap parking spots.
- Assigned government-vehicle parking spots.
- Loading zones: Don't park more than 20 minutes.
- Two-hour visitor parking: Don't park more than two hours.
- Parking in a tow-away zone will result in a ticket, towing, and impound of the government vehicle.

Please park private and government vehicles legally. Also, please drive safely and responsibly around the Lab and to and from work.

Celebrating Service

Congratulations to the following LANSCE employees celebrating service anniversaries this month:

Jaroslaw Majewski, LANSCE-LC	15 years
Tim Medina, LANSCE-LC	5 years